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ORIGINAL

FLOOD INSURANCE STUDY

BOROUGH OF SWOYERSVILLE, PENNSYLVANIA

LUZERNE COUNTY

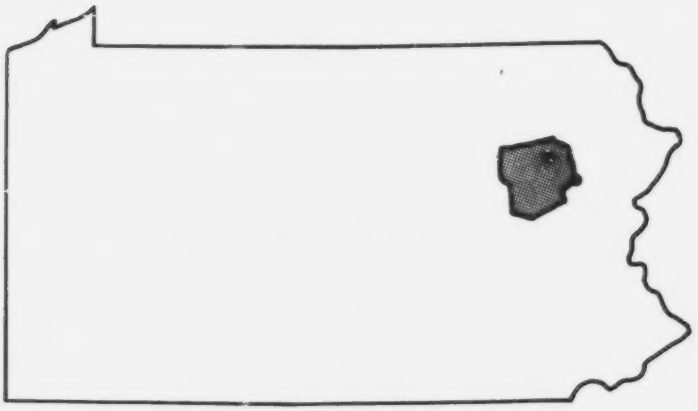

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TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Coordination	1
	1.3 Authorization and Financing	1
	1.4 Acknowledgements	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	4
	2.4 Flood Protection Measures	4
3.0	ENGINEERING METHODS	5
	3.1 Hydrologic Analyses	5
	3.2 Hydraulic Analyses	5
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	9
	4.1 Flood Boundaries	9
	4.2 Floodways	10
5.0	INSURANCE APPLICATION	11
	5.1 Reach Determinations	12
	5.2 Flood Hazard Factors	12

TABLE OF CONTENTS - continued

	Page
5.3 Flood Insurance Zones	12
5.4 Flood Insurance Rate Map Description	13
6.0 OTHER STUDIES	13
7.0 LOCATION OF DATA	14
8.0 BIBLIOGRAPHY AND REFERENCES	14
9.0 FLOOD INSURANCE STUDY UPDATES	15

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Frequency-Discharge, Drainage Area Curves	6
Figure 3 - Floodway Schematic	11

EXHIBITS

Flood Profiles Susquehanna River	Panel 01P
Flood Boundary and Floodway Map	Panel 420627 0001
PUBLISHED SEPARATELY:	
Flood Insurance Rate Map	Panel 420627 0001

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the Borough of Swoyersville, Luzerne County, Pennsylvania, and to aid in the administration of the Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Swoyersville to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

Hydrologic information was coordinated with the Baltimore District, U. S. Army Corps of Engineers, the Harrisburg District Office, United States Geological Survey and the Pennsylvania Department of Environmental Resources. Hydraulic calculations for the Susquehanna River were coordinated with the U. S. Army Corps of Engineers. A final coordination meeting was held with Swoyersville Borough officials on October 23, 1975, to review the study information.

1.3 Authorization and Financing

This Flood Insurance Study was conducted by the Susquehanna River Basin Commission at the request of the Federal Insurance Administration, U. S. Department of Housing and Urban Development. The source of authority for the study is the National Flood Insurance Act of 1968, as amended. Authority and financing are contained in Contract No. H-3496 between the contractor and the Federal Insurance Administration.

1.4 Acknowledgments

Work maps for this study were compiled by Quinn Associates. Profiles and floodways were computed and flood boundaries delineated by Century Engineering for the Susquehanna River Basin Commission.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Borough of Swoyersville, Luzerne County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

This study includes detailed analyses of the Susquehanna River, which affects the Borough of Swoyersville, the portion of Abrahams Creek of Forty Fort* 700 feet downstream of Main Street, and up to the corporate limits, and the portion of Wade Run 740 feet downstream of Main Street, and up to its mouth. The upper portions of Abrahams Creek of Forty Fort and Wade Run were not studied because they presented no major flooding hazards to the study area. Overflow ponding areas along these streams are delineated using detailed methods. The area studied in detail was chosen with consideration given to present development only.

2.2 Community Description

The Borough of Swoyersville is located in the northeastern portion of Luzerne County, northeastern Pennsylvania. The Borough is surrounded by the adjacent Boroughs of Forty Fort, Luzerne, West Wyoming, and the Township of Kingston. Swoyersville was incorporated November 27, 1888 from portions of Kingston Township, which was first settled in 1769. In 1970, 6,786 persons resided within the 1.66 square mile area of the Borough. The population increased 0.5 percent between 1960 and 1970.

The Susquehanna River flows southwest past the Borough which is located on the northwest side of the River. While not located immediately adjacent to the River, the Borough is affected by River flooding. Abrahams Creek and several small tributary streams, including Wade Run, flow through the Borough to the Susquehanna River.

The climate in this area is generally continental but is modified by the effects of the Atlantic Ocean and the Gulf of Mexico. Average annual precipitation in the area is 36.8 inches. Precipitation is reasonably well distributed throughout the year. Average annual

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* NOTE: Since the channel diversion of Abrahams Creek by U. S. Army Corps of Engineers and for the simplicity of computing profiles in this study, Abrahams Creek of Forty Fort is that Creek whose source lies within the Borough of Swoyersville (South Branch) and flows generally south into and through the Borough of Forty Fort up to its mouth at the Susquehanna River.

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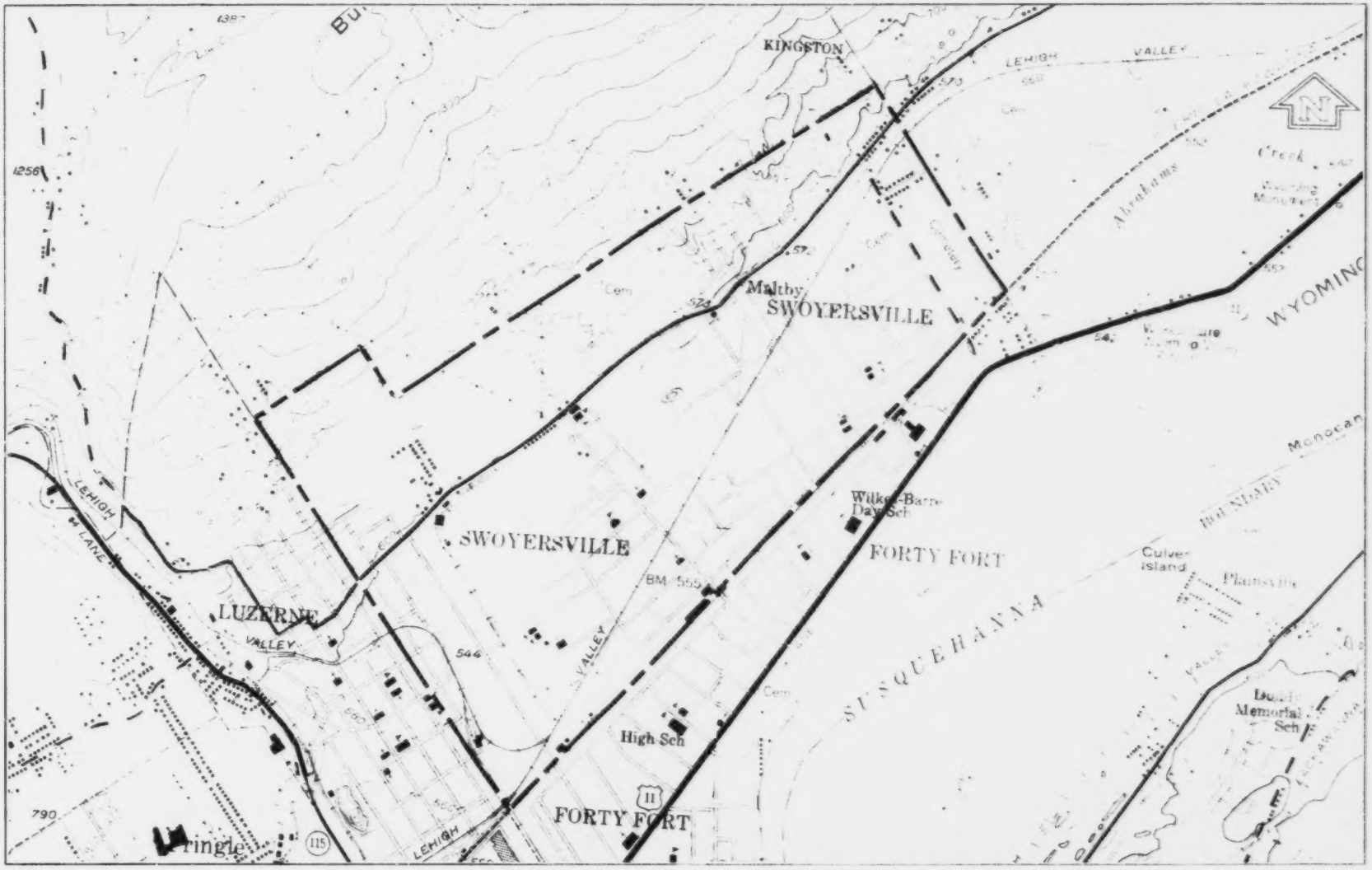

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SWOYERSVILLE, PA

(LUZERNE CO.)

APPROXIMATE SCALE

0 2000 4000 6000 8000

VICINITY MAP

snowfall ranges between 40 to 80 inches which is equivalent to four to eight inches of the total annual precipitation (Reference 7).

The Borough lies in the fairly broad natural flood plain of the Susquehanna River. The study area is situated in the Valley and Ridge Province, an area containing ridges and valleys running roughly parallel in a northeast-southwest direction (Reference 7).

2.3 Principal Flood Problems

Historic data and information from this study indicate that the Susquehanna River, Abrahams Creek, and Wade Run are the principal sources of flooding problems within Swoyersville Borough. The Borough has been subject to damages from a number of past floods. Most notable of these occurred in March of 1936 and June of 1972. The 1972 flood has a recurrence interval of approximately 300 years.

Extensive areas in the eastern and central portions of Swoyersville Borough are inundated by 100-year flooding events on Abrahams Creek and Wade Run. Much of this inundation is a result of channel overflow into natural ponding areas. All types of land uses are located within these areas. In the event of a 500-year flood on the Susquehanna River the majority of the Borough would be inundated.

2.4 Flood Protection Measures

A local flood protection project consisting of a wall and levee along the Susquehanna River reduces the flood hazard from the Susquehanna River to the Borough and diverts a portion of Abrahams Creek from flowing into Swoyersville Borough. Flood waters from 100-year flooding events on the Susquehanna River are contained by the existing River levee system. However, 500-year flooding from the river would inundate the majority of the Borough. A local flood protection project is proposed on Abrahams Creek to reduce the flood hazard from Abrahams Creek. This project is expected to be under construction in Spring 1976. The portion of Abrahams Creek upstream from Wade Run is blocked by a small dam which crosses the creek and which is intended to prevent backflow from Wade Run. A pumping station in that area serves to reduce flood elevations in the ponding area created by the dam.

Five upstream dams contribute to the reduction of the flood hazard from the Susquehanna River. These include: Arkport Dam on the Canisteo River; Almond Lake on Canacadea Creek; Whitney Point Lake on the Otselic River; East Sidney Lake on Ouleout Creek; and Stillwater Lake on the Lackawanna River.

3.0 ENGINEERING METHODS

For flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10-, 50-, 100-, and 500-years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the streams.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

Discharges for the Susquehanna River were obtained from discharge-frequency curves for the stream gage at Wilkes-Barre as published by the U. S. Army Corps of Engineers. Wilkes-Barre is located about 0.9 miles downstream from Swoyersville. The gage has been in operation since April of 1899.

The discharges for Abrahams Creek were obtained from the modified PSU III method (Reference 13). These discharges were further modified for the effects of urbanization in order to correspond with the discharges computed by the Pennsylvania Department of Environmental Resources.

The discharges for Wade Run were obtained from the rational method using a "C" factor of 0.3 (Reference 12). The design rainfall was taken from the report by Reich, McGinnis and Kerr (Reference 8). The time of concentration was taken from the nomograph in Design of Small Dams (Reference 4).

Peak discharge values, for the Susquehanna River, Abrahams Creek, and Wade Run are shown in Figure 2.

Hydrographs were computed for the mouth of Abrahams Creek and the portion of Abrahams Creek upstream from Wade Run. The triangular unit hydrograph method described in Design of Small Dams was used to obtain the hydrographs (Reference 4). A 6 hour design storm was used and the runoff curve number adjusted to match the peak given in Figure 2. The design rainfall was obtained from Reich, McGinnis and Kerr (Reference 3), and the storm distribution was determined as described by Kerr et al (Reference 8). These hydrographs were used for the storage routing and ponding computations.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the community were carried out to provide estimates of the elevations of floods of

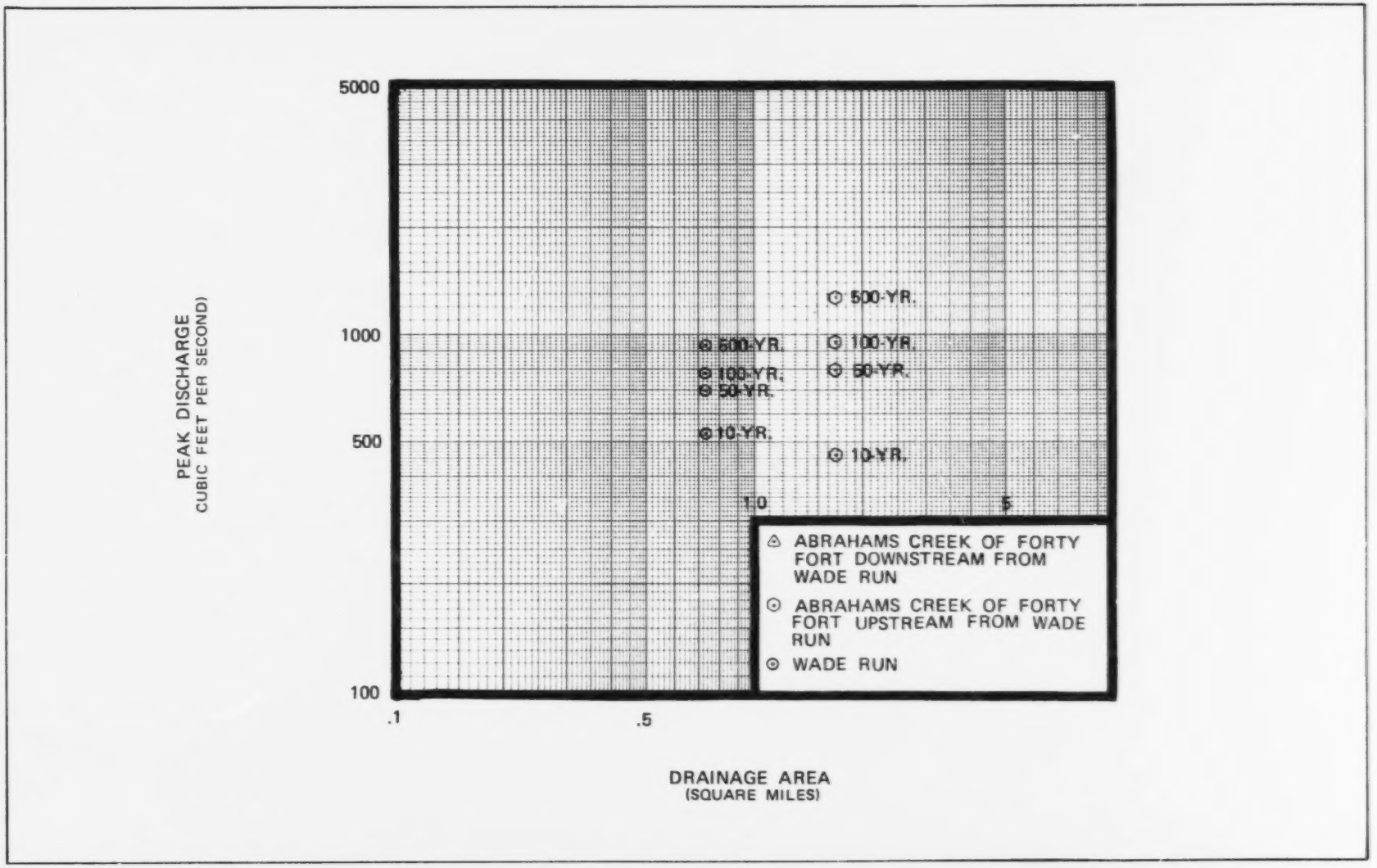

FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SWOYERSVILLE, PA
(LUZERNE CO.)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

ABRAHAMS CREEK OF FORTY FORT (SOUTH BRANCH) AND WADE RUN

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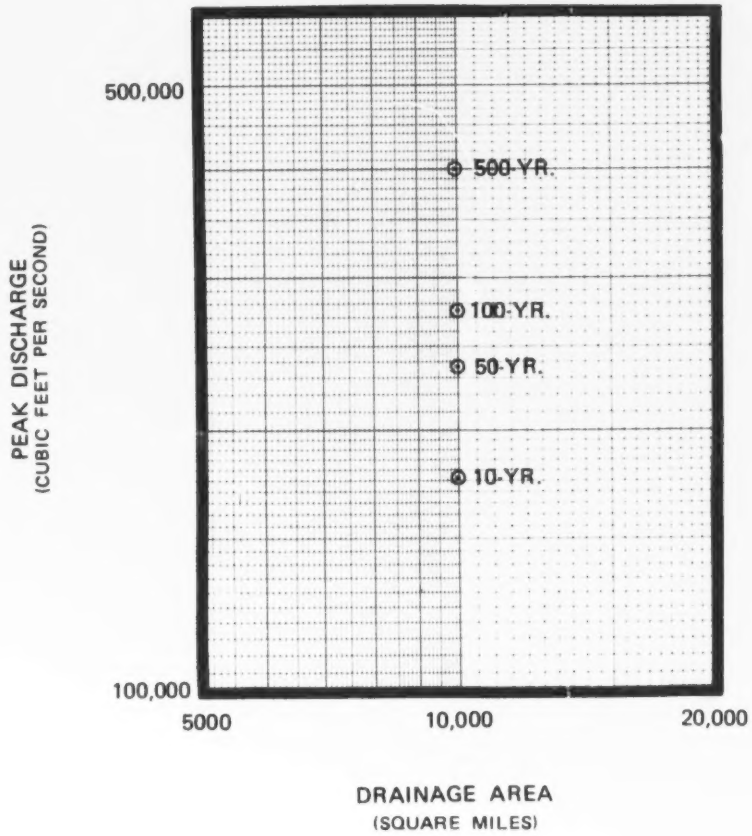


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SWOYERSVILLE, PA
(LUZERNE CO.)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

SUSQUEHANNA RIVER

the selected recurrence intervals along each stream studied in detail. Cross sections were located at regular intervals along the stream length and at significant changes in ground relief and land use or land cover. Four cross sections were used to analyze the Susquehanna River through Swoyersville. Four and seven cross sections were used to analyze Abrahams Creek and Wade Run, respectively, through Swoyersville. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Boundary and Floodway Map (Exhibit 2). Ground elevations for the cross sections were interpolated from contours and spot elevations on the 1"=200' scale base maps, or photogrammetrically obtained as the base maps were prepared (Reference 11). Channel bottom elevations for the Susquehanna River were obtained from existing profiles provided by the U. S. Army Corps of Engineers. Channel bottom elevations for Abrahams Creek and Wade Run were taken from field-surveyed profiles of the bottom with an interval distance of not more than 1,500 feet.

Backwater computations for the Susquehanna River were started using the slope area method at the first river section located about 11.7 miles downstream from Swoyersville.

Profile starting elevations were determined by the Susquehanna River Basin Commission. Flood profiles were calculated using the U. S. Army Corps of Engineers HEC-2 water-surface profiles computer program (Reference 9).

Reach lengths for the channel were measured along the centerline of channel between sections as scaled from the 1"=200' scale mapping or stream bottom profiles. Overbank reach lengths were scaled from the 1"=200' scale mapping measured along the approximate centerline of the effective out-of-channel flow area.

Manning's "n" was evaluated from aerial and ground level photographs, topographic maps and on-site field examinations. The "n" value was selected from tables published by Ven Te Chow (Reference 5), and the Bureau of Public Roads (Reference 6), based on channel conditions and overbank vegetation or land use. Within the Swoyersville Borough limits the channel "n" value was 0.037 and the overbank "n" value was 0.044.

The hydraulic model was tested and the "n" values adjusted within an acceptable range to best fit known highwater marks and/or elevations at gaging stations for the Susquehanna River from the southern boundary of Plymouth Township to the Lackawanna-Luzerne County line. All gaging station elevations were determined by the Susquehanna River Basin Commission based on established rating curves. Highwater marks obtained by the United States Geological Survey for the June 1972

flood were used. The 1972 flood has a recurrence interval of approximately 300 years.

When a satisfactory model was achieved, water-surface profiles were computed for floods with recurrence intervals of 10-, 50-, 100-, and 500-years. Flood Profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). All elevations are measured from mean sea level datum. There were no accurate elevation reference marks in the Borough because of land subsidence in the area. Elevation references should be taken from the Monument in the Public Square in the City of Wilkes-Barre, Pennsylvania - Elevation 550.25 feet.

The procedure for Abrahams Creek and Wade Run was essentially the same as described above except that it was not possible to verify the profile using known highwater marks. The channel "n" values ranged between 0.041 and 0.054 and overbank "n" values ranged from 0.048 to 0.090. The starting elevations were determined by routing the 100-year flood through the ponding area at the mouth of Abrahams Creek. The stage-storage curve was obtained from the 200' scale maps. The rating curve for the outlet under the levee was obtained from the Pennsylvania Department of Environmental Resources.

The portion of Abrahams Creek upstream from Wade Run is blocked by a dam which crosses the creek and which is intended to prevent backflow from Wade Run. As a result, Abrahams Creek ponds behind the dam. The backwater computations provided unrealistically high elevations for this area and so the entire area was treated as a ponding area, and the storage elevation determined by storage calculations. The average depth of the pond is designated as 3.0 feet.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance

Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year flood have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of five feet (Reference 11). In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown. For the ponding areas studied in detail the 100-year boundary has been delineated using storage elevations determined by storage calculations and interpolated onto topographic maps at a scale of 1:2,400 with a contour interval of five feet (Reference 11).

Small areas within the flood boundaries may lie above the flood elevations, and therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

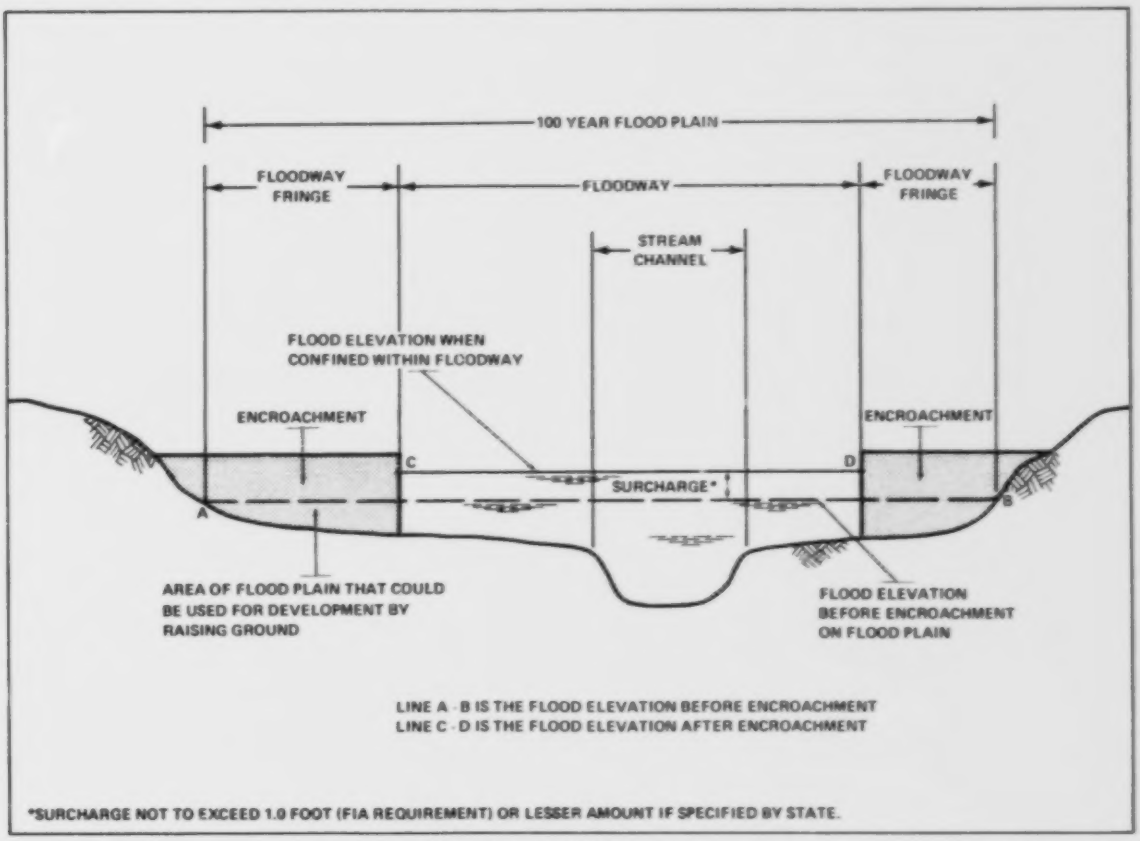
Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a proposed floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. At the final coordination meeting the community decided to change the ponding areas originally designated floodways to flood fringes.

The floodway proposed for this study was computed on the basis of equal conveyance reduction from each side of the flood plain. Floodway boundaries do not encroach on the waterway channel beyond the top of the banks, even if, as in many cases, the resultant rise in water-surface was less than the allowable one foot. The results of these computations are tabulated at selected cross sections for each stream studied in detail (Table 1).

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. The floodway boundary

for the Susquehanna River is beyond the Borough's corporate limit and therefore not shown with the accompanying map. For Abrahams Creek the floodway is contained within the channel downstream of a small dam, while upstream of the dam the floodway lies within the ponding area, for these reasons the floodway is not represented for Abrahams Creek.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than one foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 3.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 3

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the Borough of Swoyersville.

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5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

Two reaches meeting the above criteria were required for the flooding sources of Swoyersville. These included one on Wade Run and one on Abrahams Creek of Forty Fort. The locations of the reaches are shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire incorporated area of Swoyersville was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zones A1, A2, A6:	Special flood hazard areas inundated by the 100-year flood, with base flood elevations determined and zone designations assigned according to the Flood Hazard Factor.
Zone B:	Area between Zones A1, A2, A6, and the limits of the 500-year flood.
Zone C:	Area not subject to flooding by the 500-year flood.

Table 2, "Flood Insurance Zone Data," summarizes the flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Borough of Swoyersville is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

The U. S. Army Corps of Engineers has prepared a Flood Plain Information Report for Luzerne County, including the Susquehanna River in the Swoyersville area. The Intermediate Regional Flood profile included in that report was computed in consideration of two upstream reservoirs (Tioga-Hammond and Cowanesque) which are not yet in operation. Their effect is not considered in the computations in this report because adequate progress has not been made on these reservoirs to permit their inclusion as defined by the Brooks Amendment to the Flood Insurance Administration guidelines. This study is authoritative for purposes of the Flood Insurance Program. The Susquehanna River Basin Commission has completed Flood Insurance Studies for the adjacent municipalities of Forty Fort, Luzerne and West Wyoming on a regional study basis, ensuring agreement of study information across municipal boundaries.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Curtis Building Room 700, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

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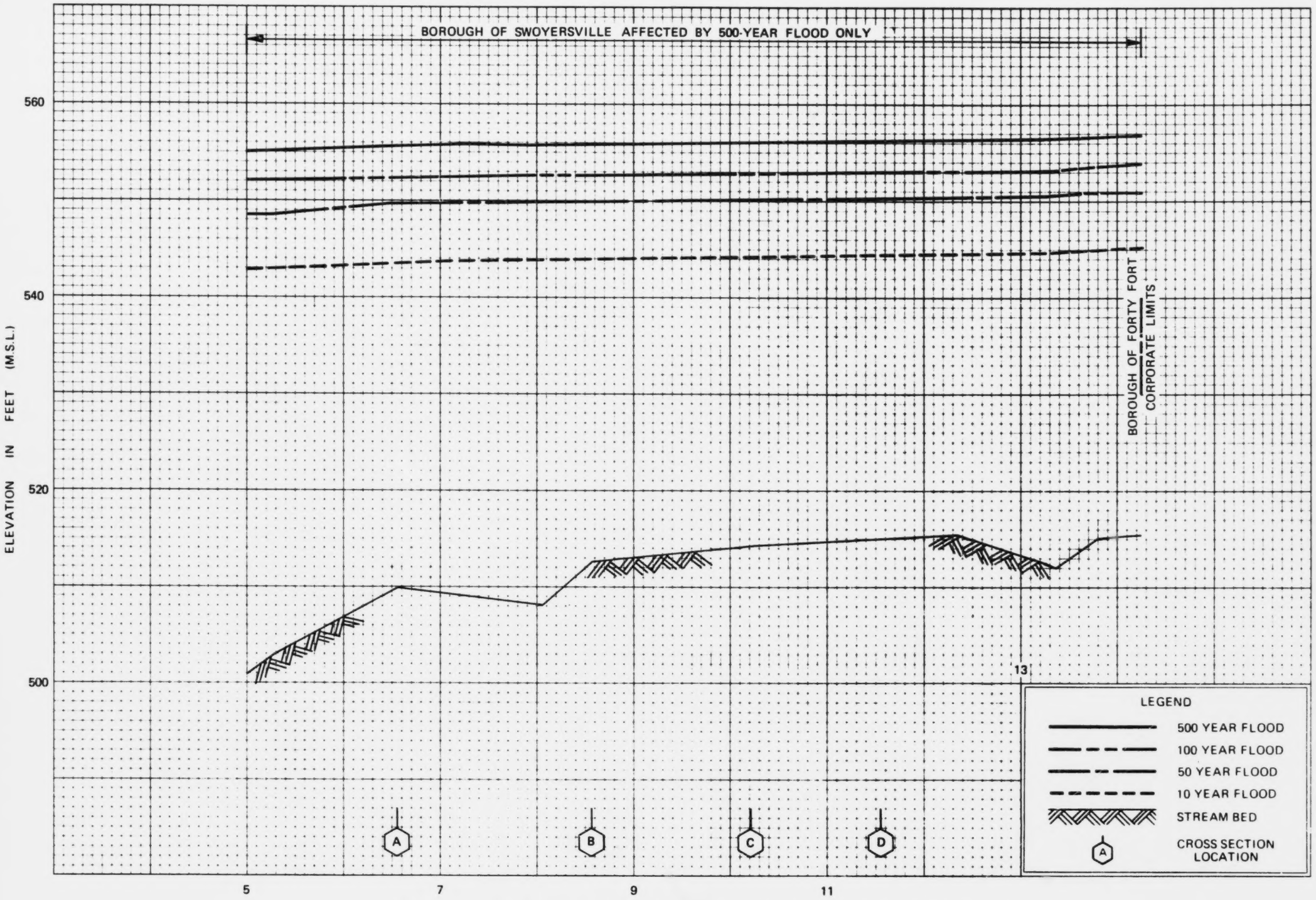
11. Flood Plain Maps - Borough of Swoyersville, Pa., The Susquehanna River Basin Commission, Mechanicsburg, Pennsylvania, October 31, 1973, Wyoming Valley Reach.

12. Beard, Leo R., Statistical Methods in Hydrology, Sacramento District, U. S. Army Corps of Engineers. January 1962.

13. Reich, B. M., et al, Flood Peak Frequency Design Manual PSU III, Civil Engineering Department, the Pennsylvania State University, June 1971.

9.0 FLOOD INSURANCE STUDY UPDATES

1982 - The study and map was updated to reflect the changed flooding conditions brought about by the construction of a detention pond and channelization system on Wade Run and Abrahams Creek of Forty Fort. The system was designed by the Pennsylvania Department of Environmental Resources to contain the 100-year flood. However, the flooding for the 10-year, 50-year, and 500-year events was not determined. The floodway has been changed to reflect the detention areas and their connecting channels.



FLOOD PROFILES

SUSQUEHANNA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF SWOYERSVILLE, PA
(LUZERNE CO.)

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EXHIBIT 1